FACTFILE:
GCE DIGITAL TECHNOLOGY

UNIT A2 1: INFORMATION SYSTEMS

Rewarding Learning

Transmission Media

Learning Outcomes

Students should be able to:

- Define the terms bandwidth and broadband;
- describe transmission media: metal cable, fibre optic and wireless; and
- evaluate these transmission media in terms of volume of data transfer, bandwidth and security.

Content in Transmission Media

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Broadband

In telecommunications, broadband is wide bandwidth data transmission which transports multiple signals and traffic types. The medium for this kind of data transfer can be coaxial cable, fibre optic, radio (wireless) or twisted pair. Broadband refers to any high-speed Internet access that is always on and faster than traditional dial-up access. It is the popular name given to a method of connecting to the internet usually achieved by a technique known as digital subscriber line (DSL). This uses the physical connections of the telephone system, but transmits data in a way that does not interfere with the voice frequencies.

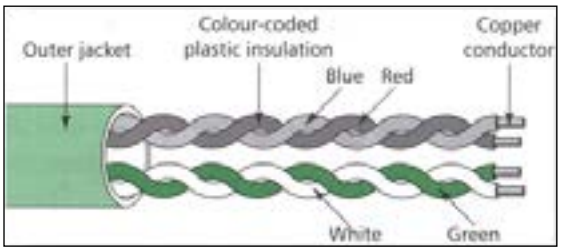
Bandwidth

Bandwidth is a measure of the capacity of a communication channel. It is the range of frequencies that a channel can handle. Bandwidth may be given as a frequency (range), such as 3 kHz, or as a transmission rate in bits per second (bps), such as 63 kbps. Transmission rate is often referred to as line speed – for example, channels might be described as having line speeds of 56k or 64k, meaning 56 kbps, or 64 kbps.

Metal cable – Twisted Pair / Coaxial

Twisted Pair
Twisted Pair is used for ordinary telephone lines. This type of cable can be classified as:
1. Unshielded twisted pair (UTP)
2. Shielded twisted pair (STP)

Unshielded (UTP)

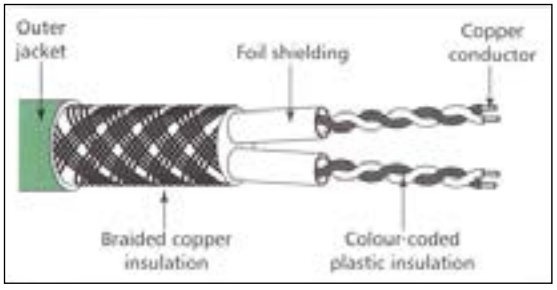


UTP is similar to STP, but has no earthed shield. In suitable circumstances they can be used for data transmission. UTP is a type of cable that consists of two independently insulated wires twisted around one another. One wire carries the signal while the other is only used to cancel out interference such as electrical interference.

Twisting it in this way reduces signal loss over any given length of cable. The media allows for very high speed data transmission, approximately up to 600 Mbps and beyond. The quality of the cable may vary from telephone grade wire to extremely high speed cable.

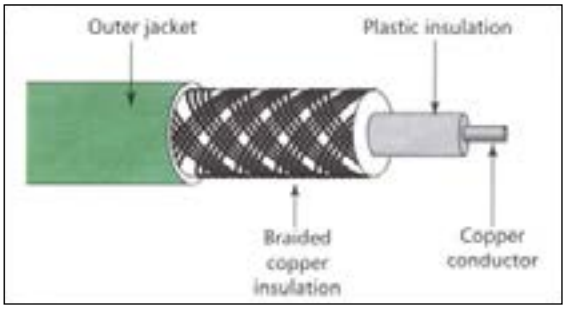
The main advantages of this type of cable are the high transmission speeds and cheap costs of insulation. The main disadvantages are the cable can only be used over a short distance, cable may be susceptible to radio and electrical frequency interference, and there are security concerns regarding the intercepting of data along such transmission lines.

Shielded (STP)
This is similar to unshielded except it has copper shielding around each pair of cables. This makes it suitable for environments where electrical interference maybe an issue. The shielding protects the data from corruption due to interference.



These cables are much less susceptible to inference and support higher transmission rate than UTP. These cables are used in an environment where electrical noises are high, like factories. However, shielding makes it harder to install. The distance limit is 100 metres.

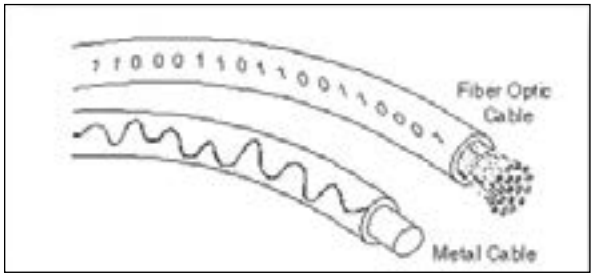
Coaxial Cable



Coaxial cable is the same kind of cable that is used for connecting a television aerial to a TV. It has two conductors – one is a wire down the centre of the cable, which may be a single strand (insulated from the second), which is made up of many strands braided around the insulation for the inner wire.

The outer shield helps protect against interference. It has the advantage of very fast transmission speeds and cheap to purchase. It has the disadvantage of being only capable for short distance communication and that it is physically inflexible.

Fibre Optic
Fibre optic cable consists of very fine glass strands that allow rapid transmission of data, using modulated light beams. Multiple strands are placed together in a single cable, each one capable of carrying one or more data signals. Fibre optic cable provides interference-free, secure data transmission and, unlike metal wires, is not subject to corrosion.



The fine glass strands are surrounded by a cladding layer and jacket. Cladding is an insulating material and jacket is a protective covering. Fibres are unidirectional (light only travels in one direction) so two fibres are used, one for sending and one for

receiving. Fibre optic is used for very high speed, long distance data transmission and is not subject to electrical interference.

The speed of metal cables is limited to the speed of flow of electricity along a wire but in this case the data travels much faster due to light.

In summary, fibre optic has the ability to transmit signals over much longer distances than coaxial and twisted pair. The data is transmitted as a series of pulses of light along thin fibres whereby each fibre can transmit in one direction.

The fibres are split into two bundles: one bundle for forward pulses and the other for return pulses. Fibre optic transmission requires repeaters to send data over long distances. At the end of each cable special devices are required to change the light pulse into an electrical signal and vice-versa.

Fibre optic cables have several advantages over traditional metal cables:

1. Greater bandwidth than metal cables, which means it has a bigger data capacity.

2. Less susceptible than metal cables to interference.

3. Data can be transmitted in digital form (the 'natural' form for a computer to use).

4. Data can travel in a secure way, impossible for hackers to intercept data.

The main disadvantage is the cable is expensive to install.

Telephone companies are beginning to replace their traditional telephone lines with fibre optic cable to facilitate demands for ever increasing bandwidth from organisations and the general public.

Wireless

Wireless covers a range of possible methods of data transmission, which can be used for linking computers within networks or for links within computer systems. Here, Bluetooth and Wi-Fi will be discussed.

Bluetooth

Bluetooth is a short range wireless communications standard that uses low-power radio waves. It allows Bluetooth equipped devices to communicate with other Bluetooth devices in a peer-to-peer relationship. If one of the devices is a computer then it can act as a gateway onto a network. An example is a mobile phone with a separate earpiece linked using Bluetooth wireless communication.

As with Wi-Fi, Bluetooth standards continue to improve, speeding up transfer times and reducing power use (very important for portable devices). The technology is likely to play a significant role in the growing Internet of Things market in the years ahead as well.

The most recent Bluetooth standard (5.0) lists a maximum theoretical speed of around 2.1 Mbps and a maximum theoretical range of 100 metres (about 330 feet), but in practice you're going to get slower speeds and shorter ranges, for now.

Wi-Fi

Wi-Fi is a way of connecting computers to a network by wireless, via radio waves. Each computer has a Wi-Fi wireless interface that connects to a wireless access point attached to the network. It is the most successful of several competing technologies.

Wi-Fi is a communication technology that makes use of radio waves in order to connect to a local area network. It is also widely used to connect to the internet from a laptop or smart phone.

If a Wi-Fi enabled device finds a network, it can connect to it by providing the correct password. Some networks are not password protected and your device will connect immediately (there are security concerns regarding these connections). The access points are called 'Hot spots'.

The Wi-Fi base station usually takes the form of a network router / ADSL modem. This router is often connected directly to the internet on a standard ADSL telephone line. This is why a device is able to connect to the internet using Wi-Fi.

Evaluate these transmission media in terms of volume of data transfer, bandwidth and security

Transmission Media	Volume of data transfer	Bandwidth	Security*
Twisted Pair (metal cable)	Depends on the category, but generally between < 100 Kbps and 100 Mbps and higher	Low	Low
Co-axial (metal cable)	Up to 10Mbps	Moderately high	Fair
Fibre Optic	100Mbps – 2Gbps	Very high	High
Bluetooth (Wireless)	Up to 25Mbps	Low	Low (but improving with 5.0)
Wi-Fi (Wireless)	Up to 250Mbps (though steadily improving)	High	Low

**generalisations and depend upon encryption used, e.g. with Wi-Fi. General comparison is based against Fibre Optic.*